ON THE FIRST OCCURRENCE OF A *CLIMACOGRAPTUS BICORNIS* WITH A MODIFIED BASAL ASSEMBLAGE, IN AUSTRALIA

Henry Moors
University of Melbourne

[Read 31st July, 1968]

Synopsis

This paper describes the first *Climacograptus bicornis* with basal spines modified by the presence of accessory spines, found in Australia, at Tallong, N.S.W. It is compared with a more complicated species *Cl. venustus* found in China and its position with respect to the evolution of *Cl. venustus* from *Cl. bicornis* discussed. The structure of the basal assemblage is described more fully than, and compared with, the Chinese species and its possible function discussed.

Introduction

In 1959, S. C. Hsu (Hsu, 1959) described a new species of *Climacograptus* with a peculiar basal modification from northwestern Hupeh, China, naming it *Cl. venustus* and showed a possible line of evolution of the species from and through other recognized species. Hsu states (*op. cit.*, p. 351) "It appears hardly possible that the complicate appendage consisting of the powerful principal spines with fully developed accessory ones could have developed directly from the simplest form with only two thin lateral spines. There must be some forms intermediate between them, which have not yet been discovered at present." He then showed how *Cl. venustus* could have been developed from *Cl. bicornis* and backed this line of descent by an analogy with the line of descent of *Cl. peltifer* from *Cl. bicornis*. However, Hsu had only two specimens, both of the same degree of development, and so could only make a guess at the evolution of his species. The finding of this specimen at Tallong, N.S.W., may help to clarify the evolutionary trend as it appears to be of intermediate development between *Cl. venustus* and *Cl. bicornis*.

Systematics

Family Diplograptidae Lapworth

Genus *Climacograptus* Hall

Climacograptus bicornis Hall subspecies.

Description

The polypary has a minimum length of 20·7 mm., excluding spines, but would have reached a greater length as the specimen studied was incomplete. The width at the sicula is only 0·8 mm. and the rhabdosome expands constantly to a maximum of 1·8 mm. at about 1 cm., after which it decreases gradually to 1·6 mm. distally. A virgula, or median septum, can be seen to run through the middle of the rhabdosome after the fourth thecal pair.

The thecae are typically climacograptid and appear to be slightly introtorted causing the aperture to be introverted into an apparently very shallow, small excavation, about 1/6th the width of the rhabdosome. Proximally the thecae number about 13 in 10 mm. with a length of about 0·7 mm., a width

of 0·3 mm. and overlap each other by about 1/3 of their lengths, while distally they number just under 10 in 10 mm. and are 1·7 mm. in length.

No sicula could be seen, but the proximal end is typified by two large horizontal spines with a single accessory spine on each. The principal spines (in the terminology of Hsu, 1959) are both crescentric and together form a parabolic curve. One is over $4\frac{1}{2}$ mm. in length while the other, being incomplete, measures only $3\frac{1}{4}$ mm., and both have maximum widths of approximately 0·3 mm. About one quarter of the way from the sicula each spine carries an accessory which is parallel to the rhabdosome, and measures approximately 1 mm. in length (1·1 mm. and 0·8 mm.); it is of constantly tapering shape and maximum width of 0·2 mm. The principal spines are made up of two portions (Fig. 1, a), the main portion being a solid (?) rod extending for the whole length of the spine and supporting underneath it a thin tube for about two thirds of its length. The solid rod does not appear to be affected by the accessory spines.

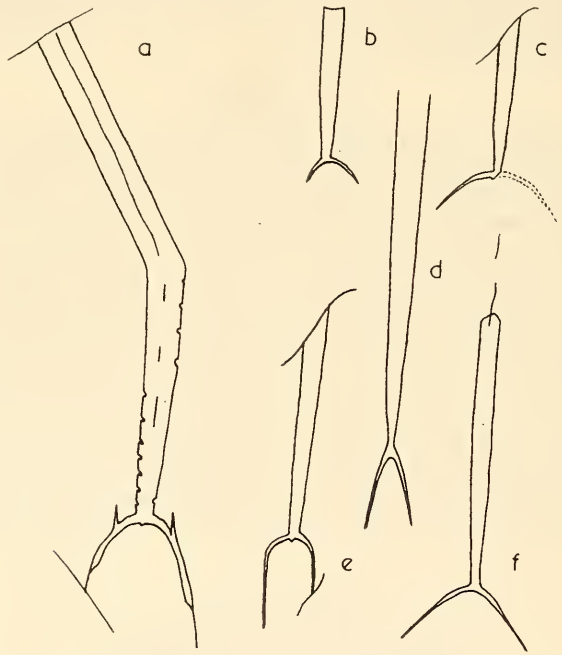

Fig. 1. Camera lucida drawings of actual specimens from locality 9, Tallong. (a) The *Climacograptus* described in this paper, ×5. (b) to (f) *Cl. bicornis* from the same locality as (a) showing the large range of size of rhabdosome and modifications of basal spines; all ×$2\frac{1}{2}$.

This assemblage is markedly asymmetrical, the spines are of different lengths (one is incomplete but by comparison with the other can be estimated to be shorter); in this obverse aspect the right hand spine is larger than the left and also carries an accessory spine larger than that carried by the other.

Discussion

The specimen here described varies little from both *Cl. bicornis* and *Cl. venustus* appearing to be a natural link between the two.

The nature of the principal spines is apparently clearer here than in Hsu's two specimens, and the relationship of the various components better

shown. The spines can be seen to consist of a tube of almost constant diameter supported by a thin rod which continues past its end (see Fig. 1, a) rather than Hsu's constantly tapering tube with central rod. Also there does not appear to be any constriction of the tube in the vicinity of the auxilliary spines as described by Hsu (an examination of his figures does show some irregularities in width but not as rhythmic as suggested by his description, but they could have been badly drawn).

The accessory spines appear to differ in some respects from those of Hsu. Firstly those of *Cl. venustus* are almost radially disposed on the principal spines (though less so away from the rhadbosome), Hsu comparing it to a high toothed cog, while in this specimen the accessory spines lie parallel to the rhabdosome. Although they are somewhat shorter than in Hsu's specimens, this can be explained by their more tangential position on the principal spines compared to the more radially situated spines of *Cl. venustus*, as explained above.

The function of the accessory spines must remain theoretical (see Hsu, *op. cit.*, p. 351, for some ideas and references) but the suggestion that they could be modified apertures to allow egress of internal tissue does not seem valid as the accessory spines end in a very fine point, limiting any aperture that could be there to very small dimensions, and the principal spines appear to have apertures of their own, where the supporting rod emerges from its tube. For the development of the spines of *Cl. bicornis* see Bulman, 1947, pp. 59-62.

Climacograptus bicornis is a very widespread species, specimens having been found from probably all the graptolite bearing strata of appropriate age. It is very diagnostic in appearance and is easily identified *sensu lato*. However, it is exceedingly variable in size, and shape of the basal assemblage, and already has been subdivided into a number of species and subspecies on the basis of these. The validity of many of these differentiates must be questionable as there is often a complete gradation from one to the next or to *Cl. bicornis sensu lato*.

Ruedemann (1908, pp. 80–85, 1947, pl. 72, fig. 52) and many others have shown the variability of the basal assemblage and size of the rhabdosome, and Fig 1, b–f shows the great variation found at just one locality. This makes one wonder at the value of separating the species into a number of subspecies as there must be only arbitrary divisions between them and they are apparently of little stratigraphic use (many different forms found together). So far apparently only three specimens (two of *Cl. venustus* and this one) have been found indicating that this stage of development of *Cl. bicornis* would be of academic rather than practical interest. The specimen here described is therefore not separated from, but merely indicated to be, a subspecies of *Cl. bicornis*.

Evolution

Hsu envisaged a line of descent (see Fig. 2, a–d) from *Cl. bicornis* with straight extended spines, step (i), through one with drooping spines (ii), then drooping spines with short projections (iii) to *Cl. venustus* with large projections, step (iv). The finding of this specimen would rather indicate that step (iii) should be a species with drooping spines and only one fully grown projection, and an extra step with two fully grown extensions added before the final stage *Cl. venustus* (h–a). Hsu's concept of small size and excess spinosity pointing to the probability of it being a relic form seems to be backed up stratigraphically here.

Material

Only one specimen was found, preserved as a flattened metallic film in fine black slate. The specimen was incomplete, both the distal and part of the proximal end lying off the slab (see Fig 1, a). The graptolite had undergone deformation before fossilisation being bent about 1 cm. from the sicula and the distal portion undergoing some torsion as well. The specimen was given to the National Museum of Victoria where it holds the number P26392.

Horizon and Locality

The specimen came from the Shoalhaven River Gorge near Tallong, N.S.W., and from Sherrard's locality 9 in that area (Sherrard, 1949, p. 77).

From this locality Sherrard has identified *Dicellograptus angulatus, D. caduceus, Climacograptus bicornis, Cl. tridentatus, Cl. minimus, Orthograptus truncatus pauperatus, O. calcaratus basilicus, Cryptigraptus tricornis* and

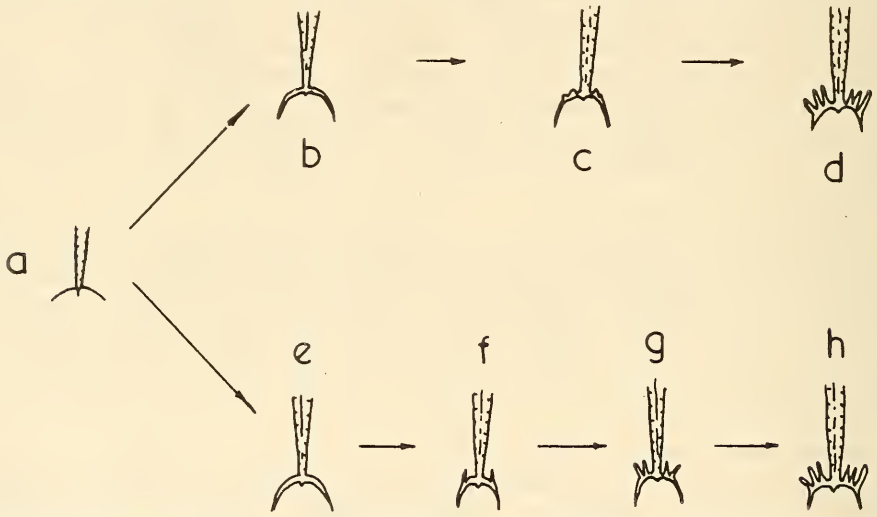

Fig. 2. Postulated evolutionary sequence of forms developing from *Cl. bicornis*, all approximately ×2. (a) to (d) as proposed by Hsu (1959, pl. 1, figs 7, 11, 12, 13), (a), (e) to (h) as proposed in this paper.

Retiolites (*Plegmatograptus*) nebula, from which she had deduced an age of Elles and Wood's "Zone 12" or the *Dicranograptus clingani* zone (*op. cit.*, pp. 64, 80, Elles and Wood, 1912). She also further subdivides the zone, stating that locality 9 represents a higher part of it. This is lower than Hsu's Wufengian or Ashgillian (zone of *Dicellograptus complanatus*) and would support the supposition that this is a link between *Cl. bicornis* and *Cl. venustus.*

Appendix

This area (Tallong) is distinctive in that all the species related to *Cl. bicornis* have their basal appendages enlarged to greater than normal size. Sherrard says (*op. cit.*, p. 69) "The development of the appendages in the former varieties which Ruedemann has studied and figured (1908, p. 80, Plate A) can be paralleled and surpassed at this place, where the length of the virgella in *Cl. tridentatus* and the size of the wings on the shield in *Cl. peltifer* greatly exceeds anything shown in Ruedemann's plate." Apparently,

conditions which suited the function of an elaborate basal appendage must have prevailed in the environment where these forms lived during this period. (See Hsu *op. cit.*, p. 351 for suggestions and references.)

Acknowledgements

The author wishes to express his thanks to Dr. F. C. Beavis, Department of Geology, University of Melbourne, for correcting the manuscript.

References

Bulman, O. M. B., 1947.—The Caradoc (Balclatchie) graptolites from limestones in Laggan Burn, Ayrshire. Part III. *Mon. pal. Soc.*, ci.

Elles, G. L., and Wood, E. M. R., 1912.—British graptolites. *Mon. pal. Soc.*, lxiv.

Hsu, S. C., 1959.—A newly discovered *Climacograptus* with a particular basal appendage. *Acta pal. Sinica*, Vol. 7, No. 5: 346-352.

Ruedemann, R., 1908.—Graptolites of New York. *New York State Museum*, Mem. 11.

———, 1947.—Graptolites of North America. *Geol. Soc. Amer.*, Mem. 19.

Sherrard, K. M., 1949.—Graptolites from Tallong and the Shoalhaven Gorge, N.S.W. Proc. Linn. Soc. N.S.W., 74: 62-82.